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WO 90/13211 A1 US 5093526 A

(58) Field of Search  
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(54) Abstract Title  
Inter-system handover in a multisystem mobile radio environment

(57) A method for determining handover between different communications systems 10, 12, 14 eg. cellular, cordless, wireless PABX. Handover may be initiated manually or automatically, by reference to records of the associations of cells belonging to different systems, stored by the mobile. The mobile can access a bulletin board which provides information on available systems and inter-system cell associations. Inter-system handover is then determined from this information. Particular cell associations include identification of domestic systems and cells on which a user is registered, identification of systems and cells from which handover commonly occurs, or which are commonly accessed, manual updates and user preferences.

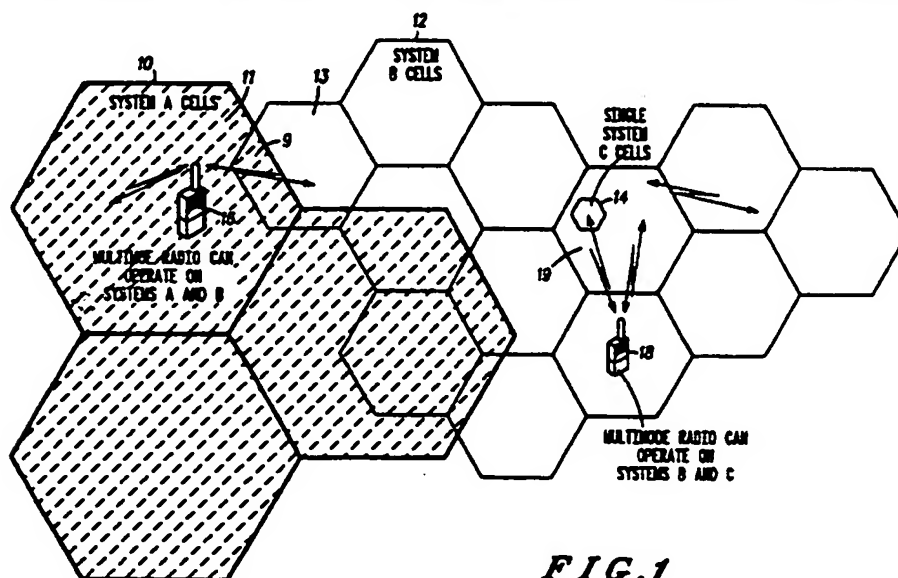


FIG.1

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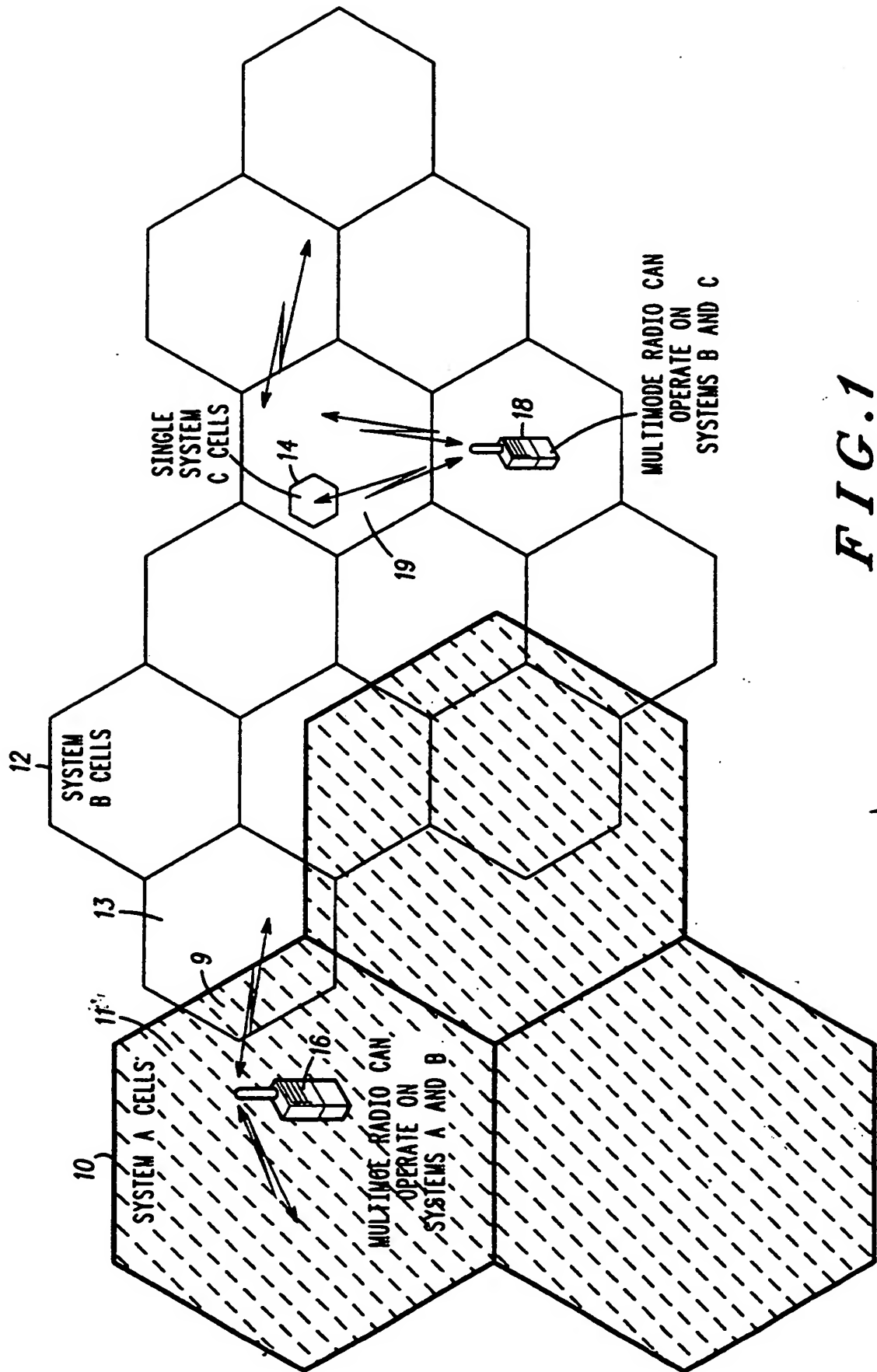
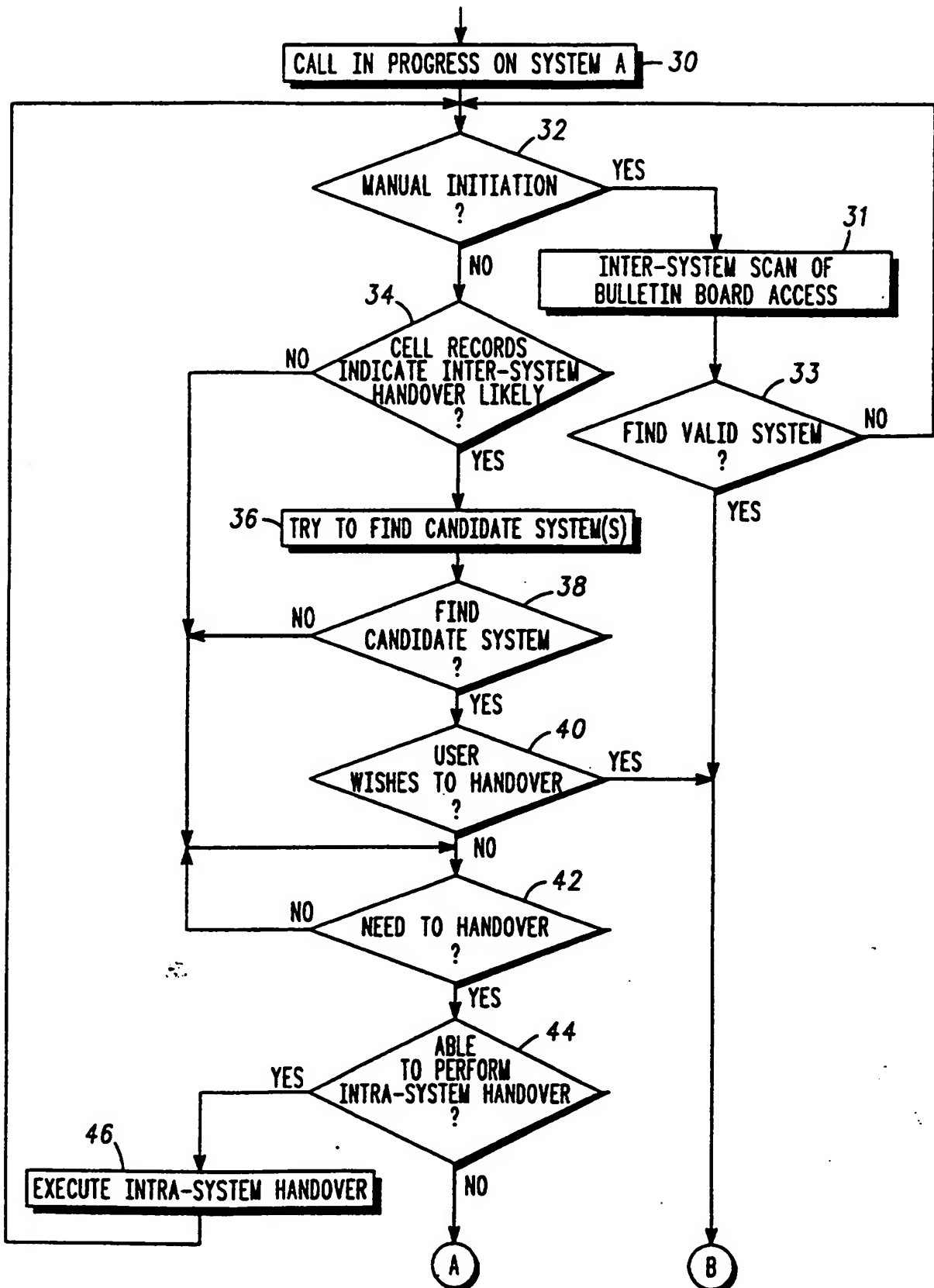


FIG. 1

FIG. 2A



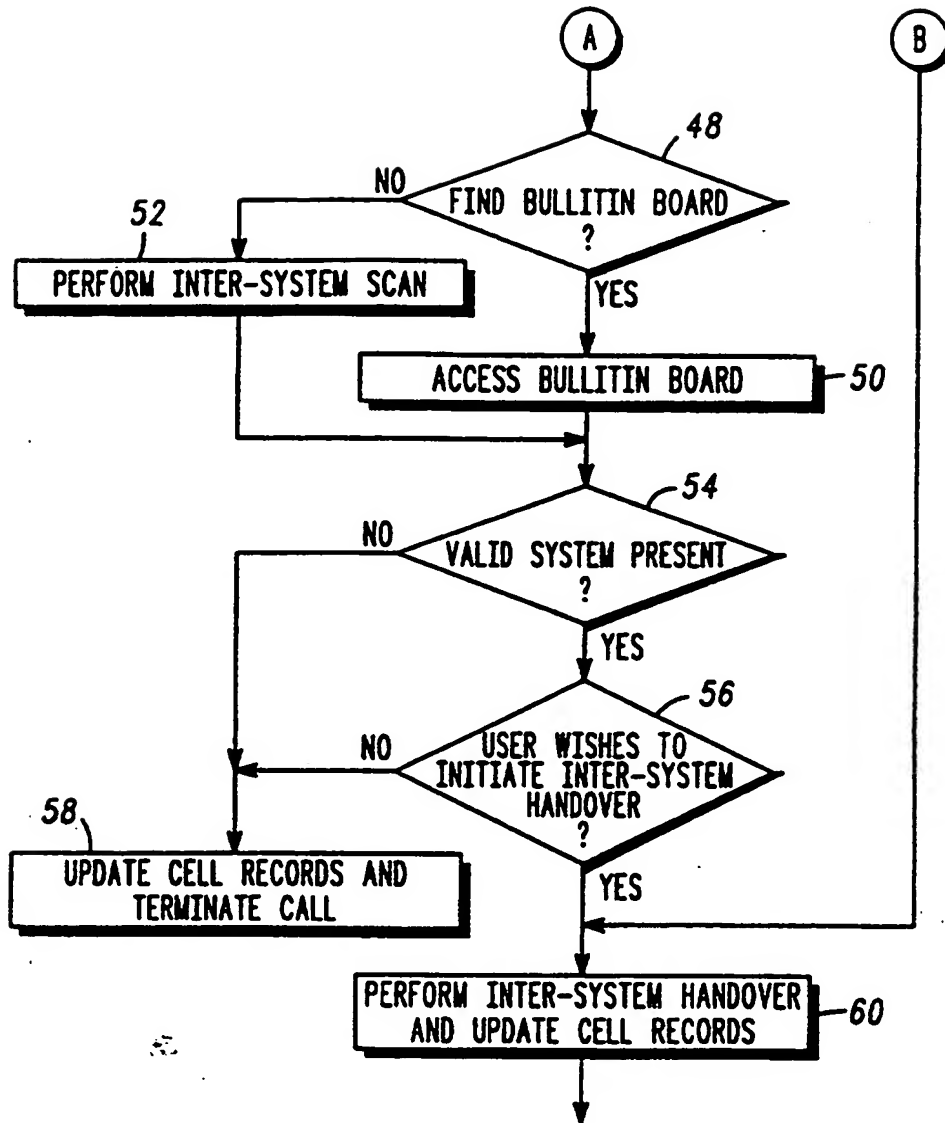


FIG. 2B

COMMUNICATIONS SYSTEM5 Field of the Invention

This invention relates in general to a method for determining an inter-system handover and more particularly to acquiring inter-system cell associations and determining an inter-system handover based on the inter-system cell associations.

Background to the Invention

Mobile radio communications systems are well known in the art. There are a variety of types of mobile radio communications systems including trunked radio communications systems and cellular radio communications systems. Such communications systems include a plurality of mobile stations that communicate via infrastructure. The infrastructure includes a base station and a system controller. There are mobile radio communications systems that include mobile stations that communicate directly to one another. There is a trend to merge as many communications services as possible so that a single mobile station may be able to communicate in a number of different communications systems.

There is a progression to allow a mobile station have the versatility to continue communication in one call while passing through a different communications system. It is a growing desire to have uninterrupted service provision between different communications systems. Thus, the ability to continue a call while crossing system boundaries is becoming increasingly important.

Examples of such cell boundaries are between a public cellular system and an indoor office wireless PABX system or between a public cellular system and a domestic cordless system. There are numerous other examples as well.

One problem with having a mobile station that has the ability to communicate in different communication environments is how to determine when to handover from one communication system to another.

Thus, it is desired to have a method of determining a handover from one communications system to another in a multi-system environment.

### Summary of the Invention

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According to the present invention, a method is provided for determining an inter-system handover in a multi-system environment including accessing a bulletin board that has information on locally available systems and inter-system cell associations.

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### Brief Description of the Drawing

FIG. 1 shows a multi-system environment.

FIG. 2 is a flow chart for a preferred embodiment of the present invention.

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### Detailed Description of the Preferred Embodiment

Referring to FIG. 1, there is shown a multi-system environment including three communications systems 10, 12, 14 each having at least one particular area of coverage commonly referred to as a cell. The size and shape of the cells are shown as merely suggestive and are not meant to be limiting. There are also shown two multi-mode radios 16, 18 that are capable of communicating in at least two of the shown communications systems.

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The communications systems each have at least one cell site that includes a coverage area that overlaps or is near to a coverage area of a cell of a different communications system. For example, a first communication system 10 includes a cell 11 that has some of its coverage area 9 overlapping or in common with a cell 13 of a second communications system 12. A third communications system 14 has only one cell that is much smaller in relation to the cells of the other shown communications systems. The entire coverage area of the cell of the third communications system 14 falls entirely within a coverage area of cell 19 of the second communications system 12. Thus, when a mobile station is near or in the overlapping coverage areas and the mobile station has the ability to communicate in either communications

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system a decision on whether to handover may be made. The criteria of such a decision may include, quality of communications, available communications resources, cost of operating in a particular communications system, etc.

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FIG. 2 shows a flow chart of a method for determining an inter-system handover including acquiring inter-system cell associations and making a determination on whether to handover based on the inter-system cell associations. Acquiring inter-system cell associations may be done by simply building a history of inter-system cell associations in terms of determining what are the parameters of the different cells and their associations to one another.

Particular cell associations are stored at the mobile stations and may for example include identification of domestic system cells on which a user is registered, identification of business system cells from which handover commonly occurs, identification of systems and cell(s) which are monitored when registered with a domestic system, identification of system and cell(s) which are monitored when registered with a business system, identification of system and cell(s) which are commonly accessed, e.g. airport, and manual updates and user preferences. An example of a domestic system may be a cordless telephone system used at home.

The identification of system and cell(s) which are monitored when registered with a system may be done in idle mode. The identification of business system cells from which handover commonly occurs or identification of other systems and cell(s) which are commonly accessed may be initially through a bulletin board.

The list of possible inter-system cell associations is not exhaustive. The inter-system cell associations are to help a mobile station adapt its behaviour to a user's usage pattern when in particular environment by providing information and a history of past behaviour in order for the mobile station to make a determination on behaviour, specifically, handover behaviour. Co-pending patent application GB 9408381.3 claims a method for determining an inter-system handover in a multi-system environment including at least two communications systems where each communication system has at least one cell site with coverage area near or in common with a cell site of a different communications system. The method includes

acquiring inter-system cell associations and building a history of such associations and determining an inter-system handover based on such inter-system cell associations.

5           FIG. 2 is a flow chart of a preferred embodiment of the present invention. In the shown embodiment when a mobile station is active in a call in communications system A as in step 30 the mobile station must first determine whether there is a manual initiation handover or user update as  
10 collection of inter-system cell associations whether a handover is likely as in step 34. Thus, the mobile station must have access to records of particular cells and their relationship to cells of different systems. Such inter-system cell associations may be user initiated or a collection of past behaviour during similar circumstances.

15           If the cell records of the inter-system cell associations indicate that a handover is likely as determined in step 34 then the cell records also indicate what the possible candidate systems are for a handover. In step 36, the mobile station attempts to find the candidate systems in terms of validating whether the candidate systems are actually available for handover as in step  
20 38.

          If a candidate system is found it must be decided whether to handover. The user may be prompted to make such a decision as in step 40. If the user wishes to handover, the mobile station performs an inter-system handover and updates the cell records or history of the inter-system cell  
25 associations with the parameters surrounding the particular handover as in step 60.

          If the user does not wish to handover to a candidate system as determined in step 40, it is determined whether a handover is necessary as in step 42. If a handover is not necessary, then the mobile station simply  
30 waits until a handover is determined as necessary in step 42.

          If a handover is necessary as determined by step 42, then it is determined whether an intra-system handover is available as in step 44. If an intra-system handover is available, then an intra-system handover is executed as in step 46 and the mobile station returns to step 32 and  
35 determines whether a manual initiation of an inter-system handover has been indicated.



If the mobile station needs to handover as determined in step 42 and is unable to handover to another cell in the currently active system as in step 44 then the mobile system attempts to find a bulletin board with information regarding locally available systems and/or inter-system cell associations as in step 48. If a bulletin board is available as in step 48 then the mobile station accesses the bulletin board in step 50 in an attempt to find a valid system available for handover as in step 54. If there is no bulletin board available as in step 48 then the mobile station performs an inter-system scan to find an available system for handover as in step 54.

10 The system controller may also perform scans for the mobile station.

If a valid system is found that is available for handover in step 54 the user may be prompted and asked if he wishes to initiate an inter-system handover as in step 56. If yes, the inter-system handover is performed and the cell records of the inter-system cell associations are updated. If the user

15 does not desire to handover as determined in step 56 then the cell records are updated and the call is terminated as in step 58.

If in step 32 a manual initiation is invoked or the user desires to attempt an inter-system handover, the mobile station performs a bulletin board access or an inter-system scan in step 31. If a valid system is found that is available for handover as determined by step 33 the mobile station is handed over to the new system and the cell records of the inter-system cell associations are updated with information regarding the handover as in step 60. If no valid system is found as determined by step 33 then the mobile station returns to step 32 and determines whether a manual initiation of an

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25 inter-system handover has been indicated.

The term handover has been used to refer to both seamless and non-seamless call continuation. A requirement of the present invention is that the mobile station may be able to operate in one or more communications systems or as a multi-mode mobile station as well as able to monitor a communications system when communicating on a different communications system.

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The provisions of accessing bulletin boards which provides information on available communications systems as described in EPO Patent Application No. 90905266.4 enables a mobile station possibly

35 establish a call handover when the mobile station has no other knowledge of a handover candidate system. The mobile station may also solicit relevant

information from various system networks regarding their availability and cell associations.

5 There may also be a broadcast of coverage cell boundary information for particular systems that allows a mobile station to update its cell records and anticipate that an inter-system call handover may be required.

10 A mobile station according to the present invention identifies when an inter-system handover is likely by recognising that the current cell is stored in a cell record of inter-system cell associations. If no possible handover candidates are found in the mobile station's cell records, the mobile station explores whether an intra-system handover is required and possible. If not possible, the mobile station will search for potential handover candidates by scanning or polling system network. If inter-system handovers are not required or desired, intra-system handovers are carried out between the cells of a system as normally required.

15 Further embodiments of the present invention include that when a handover candidate system has been identified and/or signal quality becomes poor with the handover candidate, the user may be prompted to confirm or deny handover operation and possibly choose which of the available systems to handover to. Alternatively, the handover occurrences may be triggered automatically.

20 The method combines storage of inter-system cell associations, appropriate inter-system monitoring, access to bulletin board services, the generation of a user prompt, and the processing of a user response which together enables the triggering of an inter-system call handover or re-establishment. The present invention provides a mobile station a method for  
25 having uninterrupted service over different communications systems.

## Claims

1. A method for determining an inter-system handover between different communications systems where each communications system has at least  
5 one cell site that includes coverage area near or in common with a cell site of a different communications system, the method comprising the steps of:  
accessing a bulletin board that provides information on available systems and on inter-system cell associations; and  
determining an inter-system handover based on the information from  
10 the bulletin board.
2. The method of claim 1 further comprising the step of  
updating a history of inter-system cell associations with information  
regarding the handover.  
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3. The method of claims 1 or 2 wherein the step of determining is performed at a mobile station.
4. The method of any of the preceding claims wherein the step of  
20 determining takes account of user preferences, either manually or automatically triggered.
5. The method of any of the preceding claims wherein the requirement  
for a handover is determined by quality measurements made on the  
25 communications system currently communicating over.
6. The method of any of the preceding claims wherein the requirement  
for a handover is determined by cell information broadcast on the  
communications system currently communicating over or on a bulletin  
30 board.



Application No: GB 9809393.3  
Claims searched: All

Examiner: Gareth Griffiths  
Date of search: 2 June 1998

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H4L (LDSHE, LECC, LECCX)

Int Cl (Ed.6): H04Q 7/32, 7/38

Other: Online Database: WPI

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
A	WO90/13211 A1 (MOTOROLA)	
A	US5093926 (SASUTA)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.